Multipurpose Drainage: Design Concepts and Practices for Multiple Benefits

MN State Technical Committee Meeting

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Drainage isn't a Bad Word

- Infrastructure and land use activities that depend on natural and artificial drainage:
  - **Roads** (about 132,000 miles in Minnesota)
  - **Agriculture** (about 50% of the soils in the Minnesota River Basin and Red River Basin are naturally poorly drained)
  - **Towns and Cities** (stormwater management involves surface and subsurface drainage)
- The key issue is **how** we do drainage!

Drainage Infrastructure in Minnesota as Opportunity

- Rural road ditches (116,000 miles of roads)
- Publicly administered ag ditches (est. 21,000 miles)
- Private ag ditches (maybe about the same?)
- Publicly administered ag tile (thousands of miles?)
- Private ag tile (tens of thousands of miles?)
- Urban streets, road ditches and other surface drains (est. 16,000 miles of urban roads, plus thousands of miles of surface drains)
- Urban storm sewers (thousands of miles?)

The Challenge of Terminology – Key Definitions

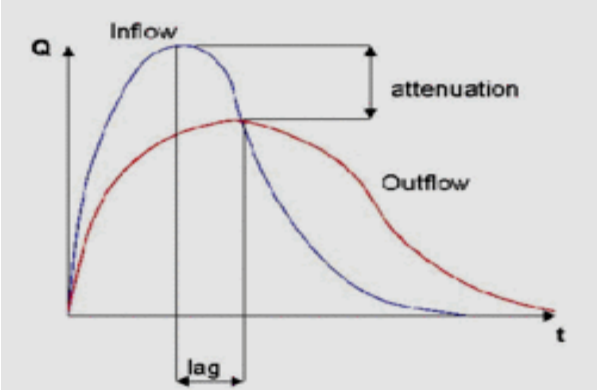
- **Multipurpose Drainage –** Engineered drainage systems that provide both private drainage benefits and public water management benefits.
- **Conservation Drainage Practices –** A subset of multipurpose drainage, with a focus on water quality protection and improvement, particularly in agricultural areas.
- Common terminology hopefully = more consensus about how to do drainage for multiple benefits

Multipurpose Drainage Goals

1. Provide adequate agricultural drainage for crop planting, productivity, and harvest;
2. Provide more equitable protection (risk control) within agricultural and urban drainage systems (upstream to downstream);
3. Reduce peak flows and flood damages;
4. Reduce erosion to improve topsoil sustainability;
5. Improve water quality by reducing erosion, pollutant concentration and carrying capacity;
6. Increase aquatic and/or terrestrial wildlife habitat.

Primary Methods for Multipurpose Drainage

- **Runoff hydrology management** (rate, timing and volume) typically to reduce peak flows and/or volume of runoff



- **Erosion reduction** practices and designs
- **Gravitational and biological treatment** of runoff (e.g. sediment settling, vegetation to trap and use nutrients, microbial breakdown of pollutants)

Minnesota River Sediment Source Fingerprinting

- Identified streambanks, bluffs and ravines as the primary sediment sources in recent time
- Are streams unstable because geomorphology is still catching up to changed hydrology?
- What can we do?
- Armor entire streams and rivers? No!
- Modify hydrology to find new stream stability sooner? Many BMPs can and do help!

Le Sueur River Sediment Budget NCED – June 2011

- Based on 2000 – 2010 monitoring and analysis
  - 66% of sediment from streambank, bluff and ravine erosion (164,000 tons/yr.)
  - 34% of sediment from uplands (84,000 tons/yr.)
  - Pre-settlement upland contribution was negligible – essentially all of sediment was from streambank, bluff and ravine erosion below the “knick point” (61,000 tons/yr.)
  - Don’t let percentages fool us - - much opportunity for upland runoff management and erosion control

Old / Traditional Multipurpose Drainage Practices

- Conservation Tillage (residue, contour strips, etc.)
- Grassed Waterways
- Terraces
- Water and Sediment Control Basins (1,600 in Winona County alone)
- Grade Stabilization Structures (4 types in NRCS Std.)
- Impoundments (Ponds, Rd. Ret., on- and off-channel)
- Vegetated Buffers and Filter Strips
- Alternative Tile Inlets

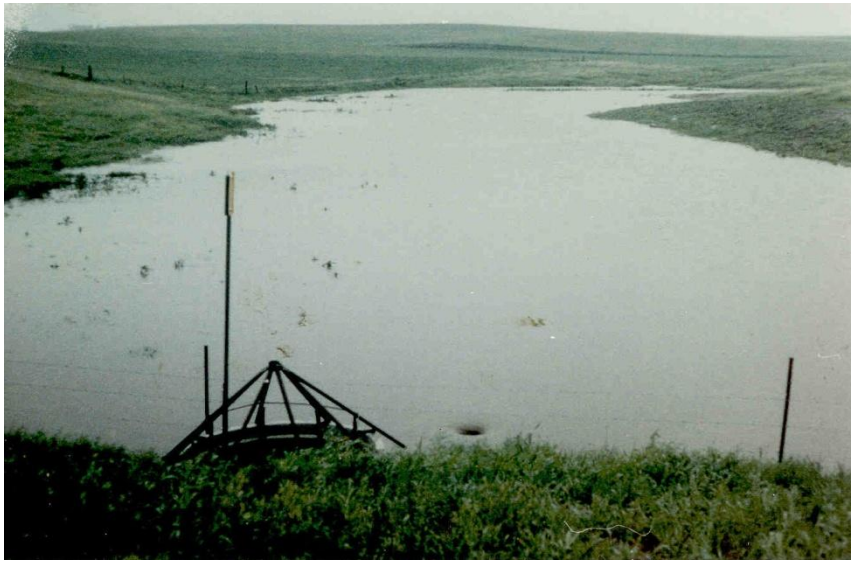
Conservation Tillage – Contour Strips

Grassed Waterways

Water and Sediment Control Basins

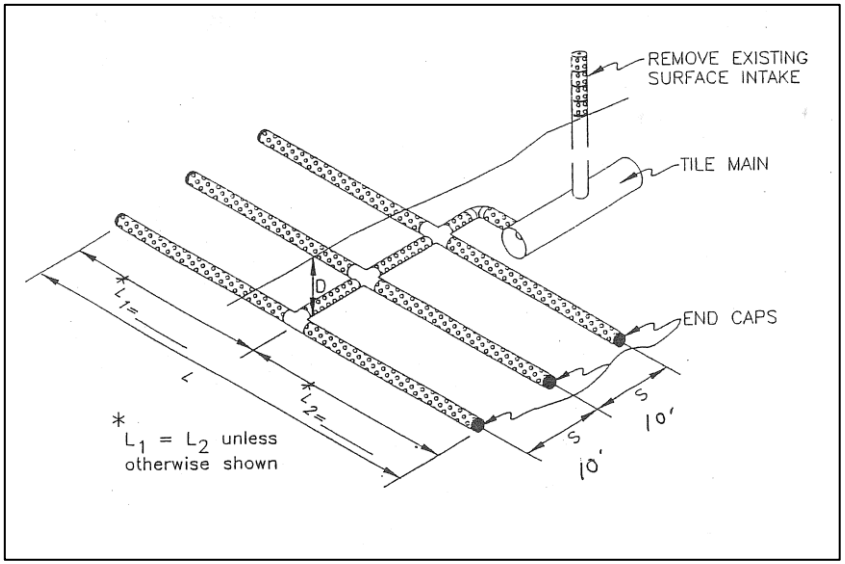
Terraces

Grade Stabilization – Side Inlet Controls



Impoundments – Ponds, Rd. Ret., etc.

Vegetated Buffers and Filter Strips



Alternative Tile Inlets

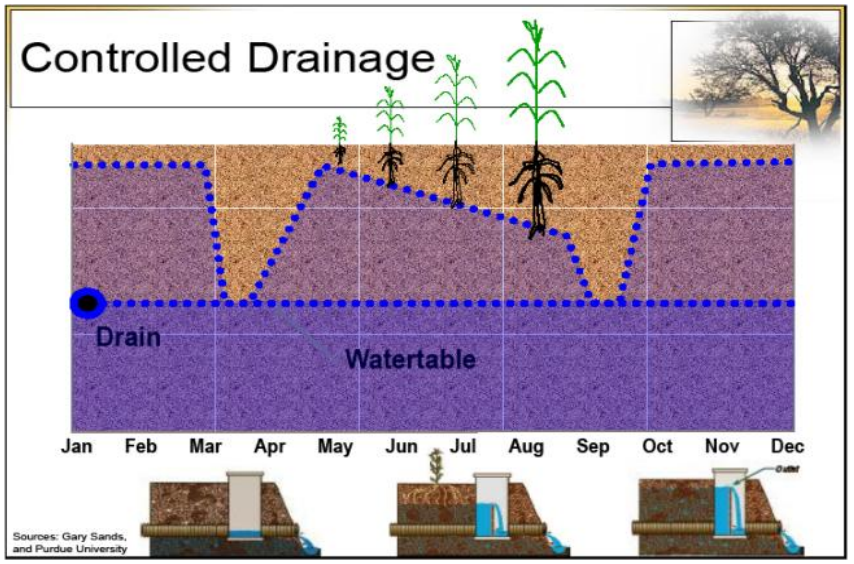
New(er) Multipurpose Drainage Practices

- Wetland Restorations and Treatment Wetlands
- Stormwater Ponds
- Raingardens
- Controlled Subsurface Drainage (NRCS – 554 DWM)
- Woodchip Bioreactors (http://www.wq.illinois.edu/DG/Equations/trifold_Bioreactor.pdf)
- Culvert Sizing (http://www.rrwmb.org/files/FDRW/TP15.pdf)
- Two-stage Ditches

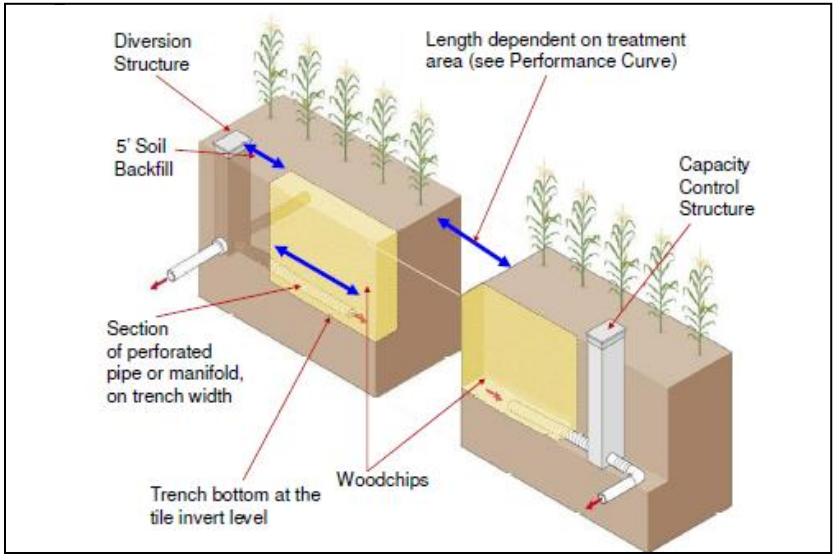
Wetland Restorations

Stormwater Ponds

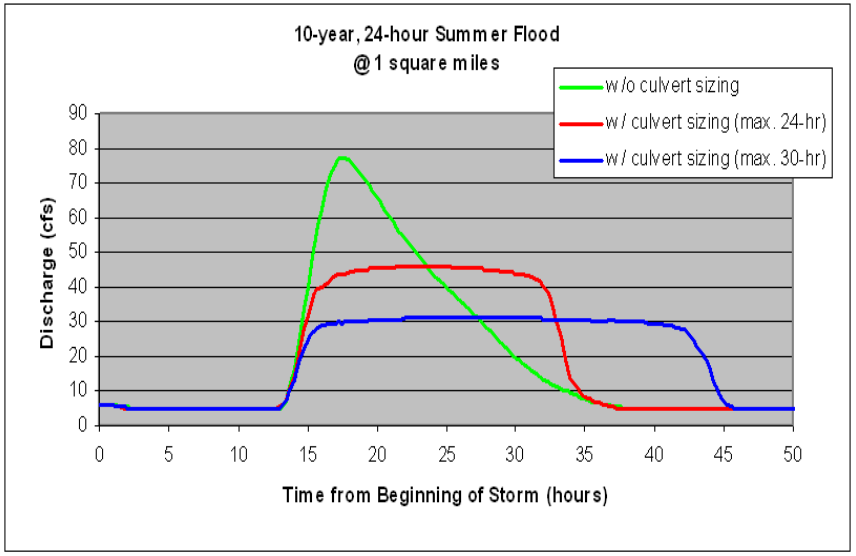
Raingardens



Controlled Subsurface Drainage

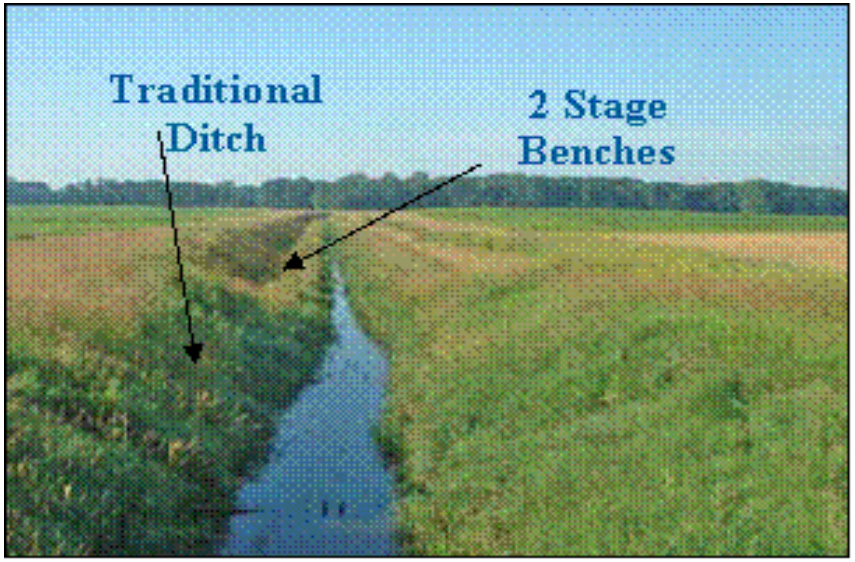


Woodchip Bioreactor



Culvert Sizing

Naturally-Formed Two-Stage Ditch



Created Two-Stage Ditch

Incremental and Watershed Approaches

- **Incremental practices on fields and farms:**
  - Random acts of conservation?
  - Or, opportunities to integrate landowner motivation, incremental funding and distributed technical assistance?
- **Drainage System or Watershed approach:**
  - Various scales (small to large drainage systems or watersheds)
  - Requires more planning, analysis and broader expertise
  - Often can better address multiple goals and opportunities
- Need to pursue multipurpose drainage using multiple approaches – – all with targeting for the best outcomes

Challenges for Multipurpose Drainage

- **Decision makers believing** – – that multipurpose drainage is worth it and doesn't unreasonably compromise a single drainage purpose (e.g. agricultural productivity or urban development).
- **How to define and integrate private and public benefits and funding?** The intersection of economic, environmental, social, and political considerations.

Multipurpose Drainage Tools

- **LiDAR topography and GIS →** help target the right practices in the right places (terrain analysis)
- **Hydrologic modeling →** continues to improve and to help analyze and design for multiple goals
- **Watershed based analyses →** provide more opportunity to identify the best locations for a suite of practices (BMP saturation)
- **Continued research and development →** add new practices and methods to the tool box

Conservation Drainage and DWM Federal and State Cost-Share

- **NRCS Environmental Quality Incentives Program (EQIP)** – Old and new conservation practices – drainage water management initiative
- **BWSR Clean Water Fund Conservation Drainage Program** – coordinated with NRCS practice standards and use of TSPs for DWM and NM planning
- Both can now cost-share on planning and structures for controlled subsurface drainage in Minnesota for existing and new tile systems (but not the tile)

Clean Water Fund
Conservation Drainage Grants

- BWSR grants to LGUs for practices on drainage systems (public and private) for water quality
- Example eligible practices:
  - Side inlet controls to drainage ditches
  - Controlled subsurface drainage planning , structures and operation incentives
  - Woodchip bioreactors
  - Nutrient management planning and incentives on controlled subsurface drainage acres
  - Alternative tile inlets
  - Multipurpose drainage planning for Chapter 103E drainage systems

Conservation Drainage Grants

- Grant Funding available to date:
  - FY 2010 $200,000
  - FY 2011 $313,000
  - FY 2012 $941,000
  - FY 2013 $1.7M (minus some admin. $)

WD, County, SWCD and TSP Roles for Multipurpose Drainage

- Assist landowners to use old and new multipurpose practices on fields and farms that are the headwaters of drainage systems **(field and farm incremental approach)**
- Assist drainage systems or watershed based projects and initiatives to use old and new practices for multipurpose water management benefits **(watershed approach)**

Bottom Line Thoughts

- Drainage is necessary
- Drainage infrastructure provides opportunity
- Many old and new agricultural and urban BMPs support multipurpose drainage goals
- Many of these BMPs work best in the headwaters of natural and artificial drainage systems
- There are far more headwaters than mainstems
- **Multipurpose drainage** is worthy of our support!